



# UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE  
United States Patent and Trademark Office  
Address: COMMISSIONER FOR PATENTS  
P.O. Box 1450  
Alexandria, Virginia 22313-1450  
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/734,713	12/12/2003	Raymond G. Beausoleil	200311116-1	2342

22879 7590 01/24/2007  
HEWLETT PACKARD COMPANY  
P O BOX 272400, 3404 E. HARMONY ROAD  
INTELLECTUAL PROPERTY ADMINISTRATION  
FORT COLLINS, CO 80527-2400

EXAMINER	
TRAN, MAI T	
ART UNIT	PAPER NUMBER
2129	

SHORTENED STATUTORY PERIOD OF RESPONSE	MAIL DATE	DELIVERY MODE
3 MONTHS	01/24/2007	PAPER

**Please find below and/or attached an Office communication concerning this application or proceeding.**

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

**Office Action Summary**

Application No.

10/734,713

Applicant(s)

BEAUSOLEIL ET AL.

Examiner

Mai T. Tran

Art Unit

2129

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 06 November 2006.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-24 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-24 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- |  |   |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)                                | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)                       | 5) <input type="checkbox"/> Notice of Informal Patent Application                       |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08)<br>Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____  |

### DETAILED ACTION

A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicants' submission filed on November 6, 2006 has been entered.

Claim 1 has been amended. No new claims have been added. Claims 1-24 remain pending in the application and which have been fully considered by the examiner.

### SPECIFICATION

The disclosure is objected to because of the following informalities:

- On page 7, paragraph [0027], line 9: "U.S. Pat. App. Ser. No. 10/364,897" is incorrect. It should be 10/364987.
- On page 14, paragraph [0052], line 2: "In a game where each state  $|s_k\rangle$  has two has two". There is a duplicate.

Appropriate correction is required.

### CLAIM REJECTIONS - 35 USC § 101

35 U.S.C. 101 reads as follows:

Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.

Claims 1-7 are rejected under 35 U.S.C. § 101 because the claimed invention is directed to non-statutory subject matter.

The claimed invention must be for a practical application by:

1. transforming (physical thing) or
2. having the FINAL RESULT (not the steps) achieve or produce a useful (specific, substantial, AND credible) concrete (substantially repeatable/non-unpredictable), AND tangible (real world/non-abstract) result.

A claim that is so broad that it reads on both statutory and non-statutory subject matter, must be amended, and if the specification discloses a practical application but the claim is broader than the disclosure such that it does not require the practical application, then the claim must be amended.

In the present case, independent claim 1 is directed to a method comprising: “constructing a state vector ..., selecting  $2N$  operators to be respectively applied to the  $2N$  qubits ..., applying each of the  $2N$  operators ..., evaluating a final state vector ..., the  $n$  players performing obligations ... An invention that is a combination of the above recited steps has no specific purpose or use. Claims that recite a computer that solely calculates a mathematical formula are not statutory.

The courts have also held that a claim may not preempt ideas, laws of nature or natural phenomena. The concern over preemption was expressed as early as 1852. See Le Roy v. Tatham, 55 U.S. (14 How.) 156, 175 (1852) (“A principle, in the abstract, is a fundamental truth; an original cause; a motive; these cannot be patented, as no one can claim in either of them an

Art Unit: 2129

exclusive right.”); Funk Bros. Seed Co. v. Kalo Inoculant Co., 333 U.S. 127, 132, 76 USPQ 280, 282 (1948).

Accordingly, one may not patent every “substantial practical application” of an idea, law of nature or natural phenomena because such a patent “in practical effect would be a patent on the [idea, law of nature or natural phenomena] itself.” “Here the “process” claim is so abstract and sweeping as to cover both known and unknown uses of the BCD to pure-binary conversion. The end use may (1) vary from the operation of a train to verification of drivers’ licenses to researching the law books for precedents and (2) be performed through any existing machinery or future-devised machinery or without any apparatus.” Gottschalk v. Benson, 409 U.S. 63, 71-72, 175 USPQ 673, 676 (1972).

The claims are not limited to a substantial practical application because they encompass arbitrary mathematical algorithms. Furthermore, the phrase “the n players performing obligations according to the results respectively assigned” are not clear in purpose or scope.

The Examiner reads the claims carefully to search for limitations to practical application i.e. utility and finds no final result achieved or produced a useful, concrete and tangible result. The claimed invention has no real world function and is not statutory.

### CLAIM REJECTIONS - 35 USC § 112

1. The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

Art Unit: 2129

Claims 1-7 are rejected under 35 U.S.C. §112, first paragraph because current case law (and accordingly, the MPEP) require such a rejection if a §101 rejection is given because when Applicant has not in fact disclosed the practical application for the invention, as a matter of law there is no way Applicant could have disclosed *how* to practice the *undisclosed* practical application. This is how the MPEP puts it:

(“The how to use prong of section 112 **incorporates as a matter of law** the requirement of 35 U.S.C. §101 that the specification disclose as a matter of fact a practical utility for the invention.... If the application fails as a matter of fact to satisfy 35 U.S.C. §101, then the application also fails as a matter of law to enable one of ordinary skill in the art to use the invention under 35 U.S.C. §112.”); In re Kirk, 376 F.2d 936, 942, 153 USPQ 48, 53 (CCPA 1967) (“Necessarily, compliance with § 112 requires a description of how to use presently useful inventions, **otherwise an applicant would anomalously be required to teach how to use a useless invention.**”) See, MPEP 2107.01(IV), quoting In re Kirk (emphasis added).

Therefore, claims 1-7 are rejected on this basis.

### CLAIM REJECTIONS - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.

Claims 1-24 are rejected under 35 U.S.C. 102(a) as being anticipated by “Experimental Implementation of a Quantum Game”, by Carsten Schuck, July 22, 2003, hereinafter Schuck.

#### Claim 1

Schuck teaches a method comprising:

constructing a state vector representing N pairs of entangled qubits (page 28, lines 6-9, page 48, line 1);

selecting  $2N$  operators to be respectively applied to the  $2N$  qubits, wherein selecting the  $2N$  operators includes each of  $n$  players selecting one or more of the  $2N$  operators for a set of the qubits assigned to the player, the operators being selected by the player according to a choice of the player regarding a cooperative effort (page 28, lines 21-23, page 29, lines 1-4);

applying each of the  $2N$  operators only to a portion of the state vector that represents the qubit corresponding to the operator (page 28, lines 21-23, page 29, lines 1-4, page 48, lines 7-9);

evaluating a final state vector that results from the application of the  $2N$  operators to thereby assign results to the players (page 29, lines 5-17); and

the  $n$  players performing obligations according to the results respectively assigned, the results designating whether respective players will cooperate in or defect from the cooperative effort (page 29, lines 5-17).

### **Claim 2**

Schuck teaches the method of claim 1, wherein  $N$  is equal to  $n$ , and each player selects 2 of the  $2N$  operators (page 28, lines 21-23, page 29, lines 1-4).

### **Claim 6**

Schuck teaches the method of claim 1, wherein software executed in a classical computer performs the step of applying the operators to the state vector (page 28, lines 21-23, page 29, lines 1-4, page 48, lines 7-9).

### **Claim 7**

Schuck teaches the method of claim 1, wherein constructing the state vector comprises setting a system in a quantum state corresponding to the state vector (page 28, lines 21-23, page

Art Unit: 2129

29, lines 1-4, page 48, lines 7-9).

**Claim 8**

Schuck teaches the method of claim 7, wherein the system comprises  $2N$  photons (page 40, paragraph 3.1.1).

**Claim 9**

Schuck teaches the method of claim 8, wherein the system is selected from a group consisting of SQUIDs, NMR systems, individual atoms, individual molecules, individual ions, cavity quantum electro-dynamic (QED) systems; and photonic systems having quantum states implementing the qubits (page 52, lines 2-5).

**Claim 10**

Schuck teaches a system comprising:

a source of multiple channels of entangled photon pairs (page 40, paragraph 3.1.1);

a plurality of stations, where each station is associated with one or more of the channels and is capable of performing a player-selected operation on states of photons associated with the station (page 58, line 1, page 75, line 1);

a first optical network that for each channel and each entangled photon pair in the channel, delivers a first photon from the entangled photon pair to a first of the stations associated with the channel and delivers a second photon from the entangled photon pair to a second of the stations associated with the channel (page 52, lines 6-7); and

a measurement system coupled to measure the states of the photons after delivery to the stations (page 51, paragraph 3.3).

**Claim 11**



The system of claim 10, wherein in each of the entangled photon pairs, a first polarization state of the first photon depends on a second polarization state of the second photon.

**Claim 12**

Schuck teaches the system of claim 11, the player-selected operations of the stations change polarizations states of the photons (page 58, line 1, page 75, line 1).

**Claim 13**

Schuck teaches the system of claim 12, wherein each station comprises:

- a polarizing beam splitter (page 58, line 1);
- a first polarization changing element in a path of a first polarization component exiting the polarizing beam splitter (page 6, lines 20-22, page 46, lines 10-13); and
- a second polarization changing element in a path of a second polarization component exiting the polarizing beam splitter (page 6, lines 20-22, page 46, lines 10-13).

**Claim 14**

Schuck teaches the system of claim 10, wherein each system consists of linear optics (page 33, paragraph 2.3).

**Claim 20**

Schuck teaches the system of claim 10, wherein the source of multiple channels of qubits comprises:

- a laser (page 40, paragraph 3.1.1); and
- a parametric down-converter capable of converting a photon from the laser into a pair of photons in an entangled state (page 40, lines 9-12).

**Claim 21**

Art Unit: 2129.

Schuck teaches the system of claim 10, wherein the source of multiple channels of qubits comprises:

a source of unentangled photons (page 40, lines 23-25); and

a system that creates entanglements between photons in different channels (page 40, lines 23-25).

**Claim 22**

Schuck teaches the system of claim 10, wherein the measurement system comprises an optical system implementing a joint operation on the entangled photon pairs (page 49, lines 11-13).

**Claim 23**

Schuck teaches the system of claim 22, wherein the optical system unentangles the entangled photon pairs (page 40, lines 23-25).

**Claim 24**

Schuck teaches the system of claim 22, wherein the optical system comprises a controlled NOT gate (page 52, figure 3.8).

**RESPONSE TO ARGUMENTS**

**Rejection under 35 U.S.C. §101 and rejection under 35 U.S.C. § 112, first paragraph**

Applicants' arguments filed have been fully considered but they are not persuasive.

Specifically, applicants argues that:

### Argument 1

The process of claim 1 is not directed to merely abstract ideas or a mathematical algorithm because claim 1 requires players to make selections and has a tangible final result of "the n players performing obligations according to the results respectively assigned." In the sentence spanning pages 4 and 5 of the Final Office Action, the Examiner grouped "the players" along with "state vector", "operators", and "entangled qubits" as being disclosed theoretically or mathematically. However, claim 1 and Applicant's specification clearly indicate that the players are physical and not mere mathematical entities. In particular, claim 1 recites "a choice of the player regarding a cooperative effort" and "designating whether respective players will cooperate in or defect from the cooperative effort." The activities of choice, cooperation, and defection are not normally assigned to or associated with mathematical entities. In support of the Examiner's interpretation of players as being theoretical or mathematical, the Examiner cited paragraph [0016] of Applicants' specification. Paragraph [0016] refers to a "player k." However, distinguishing players using an index k does not make a player a mathematical entity, in the same way that assigning a social security number does not change a person into a number. Accordingly, claim 1 clearly recites physical activities and tangible results and is statutory subject matter.

First, since the term "players" was not further defined in the claims, the Examiner was giving each term in the claims its broadest reasonable interpretation consistent with the specification. During patent examination, the claims are given the broadest reasonable interpretation consistent with the specification. See *In re Morris*, 127 F.3d 1048, 44 USPQ2d 1023 (Fed. Cir. 1997).

Upon consideration of claim 1 in light of the description, it is found that the combination of recited steps constitute a method that is carrying out a "game theory" or "game strategies" that apply "quantum operators" to implement a "quantum game". "Game theory" offers mathematical tools for analyzing games. Further, all of the limitations cited in claim 1 such as "state vector", "2N operators", "entangled qubits", and "players" are disclosed theoretically or mathematically (see specification, paragraphs [0013], [0014], [0015], [0016]). Therefore, the

Examiner's broadest reasonable interpretation of the claimed invention is pure abstract ideas, mathematical algorithms, and software per se.

Second, In response to applicants' argument that "Applicants' specification clearly indicate that the players are physical." Mere conclusory statement does not convey applicants' rationale such that the Examiner can respond in a meaningful manner. Applicants need to point out exactly where in the specification that the players are physical.

On this basis, Applicants have not shifted their burden of showing that their claims are statutory and Examiner's rejection of those claims STANDS.

### CONCLUSION

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure:

1. Miyatake, Yoshito, U. S. Patent No. 5,327,270, discloses polarizing beam splitter apparatus and light valve image projection system.
2. Ulyanov, Sergei V., U. S. Patent No. 6,578,018, discloses system and method for control using quantum soft computing.
3. Takeuchi, Shigeki, US-PGPub, 2005/0094142 A1, discloses entangled photon pair generating apparatus.
4. Shields et al, U. S. Patent No. 6,864,501, discloses photon source and method of its fabrication and operation.
5. Kumar et al, U. S. Patent No. 6,897,434, discloses all-fiber photon-pair source for quantum communications.

Art Unit: 2129

6. "Cooperative three- and four- player quantum games", Y. J. Ma, G. L. Long, F. G. Deng, F. Li, S. X. Zhang, Physics Letters A, 301, Issue 3-4, pages 117-124 (26 August 2002).
7. "Entanglement enhanced multiplayer quantum games", Du, Jiangfeng; Li, Hui; Xu, Xiaodong; Zhou, Xianyi; Han, Rongdian, Physics Letters A 302, Issues 5-6, pages 229-233 (September 30, 2002).

### **CORRESPONDENCE INFORMATION**

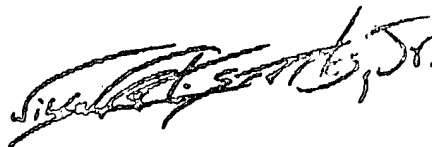
Any inquiry concerning this communication or earlier communications from the examiner should be directed to Mai T. Tran whose telephone number is (571) 272-4238. The examiner can normally be reached on M-F 9:00am-- 5:30pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, David Vincent can be reached on 571-272-3080. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Application/Control Number: 10/734,713  
Art Unit: 2129

Page 13

A handwritten signature in black ink, appearing to read "Wilbert L. Starks, Jr.", written in a cursive style.

M.T.T  
Patent Examiner

Wilbert L. Starks  
Primary Examiner  
Tech Center 2100